The Chemical Age

A Weekly Journal Devoted to Industrial and Engineering Chemistry

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The Importance of Chemical Engineering

A CLAIM has been staked by civil engineering, by mechanical engineering, and by electrical engineering, through their Chartered Institutions, to major consideration as operations of first importance in industry. We are disposed to stake such a claim also for chemical engineering. It is, of course, important that the civil engineer should build his roads, should tunnel the mountains, impound the waters in reservoirs and do the many other things which are combined within his somewhat omnibus province. Just where the chemical engineer ceases to function and other engineers should take his place is not altogether clear. The Institution of Civil Engineers at one time has been known to draw up a code for testing heat engines, a problem which even at that time appeared to be rather the problem of other engineers, and to-day is quite distinctly the problem of the chemical engineer.

To solve this difficulty of defining where chemical engineering begins and other forms of engineering have their ultimate limits, it may be assumed, broadly speaking, that when matter undergoes a change of state or of composition or both, the problem is one of chemical engineering. We are disposed to include a change of state, which is really physics, within the scope of the chemical engineer. The civil engineer and the mechanical engineer do not change the state of the materials with which they deal. Each of them takes existing materials and moulds them in one way or another into a form in which they can be used by mankind. There are borderline instances such as the manufacture of concrete. This is undoubtedly within the orbit of the civil engineer, but the changes that occur in concrete when setting are a field for the chemist and the physicist, and thus might conceivably be regarded as coming within the scope of the chemical engineer. This, however, would seem to stretch the definition rather far.

Metallurgy is another borderline case and here undoubtedly matter undergoes a change of state and frequently a change of composition through the operations of refining, melting, heat transmission, and the manufacture of alloys. We should have no hesitation in regarding metallurgy as a branch of chemical engineering. Certainly, it does not fall within the boundaries of civil, mechanical, or electrical engineering. The manufacture and utilisation of fuel

On Other Pages

other than that of mining (which presumably should strictly be considered as an offshoot of civil engineering) will come under the definition of the chemical engineer. The operations comprised within the purview of the Institute of Fuel, the Institution of Gas Engineers, and similar bodies are thus strictly inside the limits of chemical engineering even though they are not to any considerable extent included among the functions of the Institution of Chemical Engineers. Is it not a reasonable conclusion that because civil, mechanical, and electrical engineering were early in the field with strong organisations they have marked out their boundaries clearly, whereas because chemical engineering as a conscious entity is of comparatively late growth, several offshoots have formed which should be gathered together in the one organisation?

This is not a suggestion that the Institute of Fuel and the Institution of Gas Engineers should become merged into the Institution of Chemical Engineers, because at the present date that would not be feasible. It is, however, a plea that these three bodies should regard themselves as part of the chemical engineering tree and should collaborate very closely in respect of their trade associations and in respect of the technical bodies with which they are associated.

By some mischance boilers and the provision of steam are not regarded purely as a chemical engineering operation. Nevertheless, in our opinion it should be The combustion of the fuel is a chemical process and the provision of the necessary surfaces for heat transmission are essentially an exercise in chemical engineering. The boiler is a pressure vessel in which matter changes its state and it is therefore a concern of the chemical engineer. The only reason why the generation of steam is not generally considered as being a chemical engineering problem is that the process was known and operated for at least 100 years before anyone became conscious that such a thing as chemical engineering existed. Chemical engineering has penetrated deeply into almost every industry. Some industries which are generally grouped under the head of " chemical industries " consist wholly of chemical engineering. In others there is a curious mixture of chemical engineering and rule-of-thumb methods which will undoubtedly be replaced in due course by completely chemical engineering methods. There are, of course, other industries, of which textiles and leather are good examples, in which chemical engineering plays only a small part and can probably never play more than a subsidiary part. Nevertheless, chemical engineering does play some part in these industries. Probably its part is at least as great as that of electrical engineering. Because the provision of motors to drive machinery and of the power which actuates the motor is undoubtedly electrical engineering, it is freely recognised that electrical engineering forms a part of those industries and the factories generally have an electrician either engaged as a whole-time employee or available from a specialist electrical engineering firm at short notice. Because there is no such outstanding recognition of the chemical engineer, however, many of these industries feel themselves quite competent to run the chemical engineering part of their process without any expert advice either from within or without their concern, and sometimes even without a chemist.

The food industries are perhaps in a slightly different category. There is no possible doubt whatever that many of the operations of brewing and food processing are pure chemical engineering processes and they are recognised as such by chemical engineers. Some strange atavism must be responsible for the fact that no self-respecting food industry, including brewing, will have any truck with the term " chemical engineering." It is an obvious example of the ostrich putting its head in the sand, and the only thing that we can do about it is to educate the world in general to the significance and importance of chemical engineering.

We conclude by pointing to the need in the first place for conscious recognition on the part of the chemical engineers themselves of the confines of chemical engineering, and secondly for the Institution of Chemical Engineers, perhaps through a Royal Charter, to stake out in the world a claim to represent chemical engineering in its widest sense. What effect such action might have on various branches of industry in which chemical engineering plays a predominant, or at any rate an important part, we hope to be able to discuss on other occasions.

NOTES AND COMMENTS

American "Know-How"

A GOOD idea of the magnitude of the scientific and technical man-power potentialities of the United States is afforded by an article in the April issue of *Chemical and Metallurgical Engineering*, the author being Mr. Albert Elder, Head Chemical Adviser to the War Production Board at Washington. Mr. Elder's text is an examination of the efficiency with which the U.S. Government is mobilising what he calls the "know-how" of the country—what we should rather describe as its technical ability. Of some 6700 chemists and chemical engineers who will have graduated between January and July, 1943, about 1400 will be swallowed up by military demands, leaving 5400 for industrial chemistry—scarcely enough to make up for the already existing shortage of chemists of this grade. Another shortage manifests itself in the lack of trained personnel for the construction of new chemical and allied plants—synthetic rubber alone demands thousands—and these must either be trained by the existing staff, or else drawn off from other factories. Somehow or other, plant expansion must keep pace with the demands of the ever-growing military force. A complaint is made, elsewhere in the journal, that the Army is not playing its just part in the training of chemical engineers; their "Specialised Training Program" on this side of technology is severely criticised and is compared adversely with the Navy's similar classes. We seem to recall having heard parallel criticism of technical training efficiency in another Army and Navy.

Harnessing Invention

TO get back to Mr. Elder—he gives an imposing list of Government Technological Organisations, some established before America's entry into the war, others since, whose function is to regulate the supply of technical ability. In truth we can say with some degree of confidence that we are not behind America in this respect; there really appear to be some auspicious signs of good organisation behind our technical war effort. There are blots no doubt—blots are always conspicuous—but the general trend is in the right direction. One particular way of utilising "know-how" is described by Mr. Elder in a manner more detailed than we remember to have seen recorded on this side of the Atlantic. This is the utilisation of patents, both national and enemy-owned. The Office of Production Research and Development examines patents and inventions with care, for it is well said that, in war, to claim that you can do something which you can't do may have an effect equal to direct sabotage. As a result, the knowledge amassed from *useful* patents has been pooled and redistributed over various fields. In the six years 1936-41 13,672 patents were assigned to German persons or concerns, and another 800 or so to Italians and Japanese, a figure which should allow for some 50,000 Axis patents to be vested in the Office of the Alien Property Custodian. Whatever the total, it is intended to utilise, to the fullest possible extent, the useful technical knowledge contained therein. Post-war plans, too, are not forgotten. The war catalyses many inventions and acts as a spur to research. Much of the effort expended can and must be harnessed for the common good when peace comes, for, as Mr. Elder epigrammatically puts it, the war debt can be paid off by two methods—inflation or invention. Harnessing knowledge will bring the second alternative into play.

Sicily's Mineral Wealth

THE Italian decree that all non-essential civilians are to be evacuated forthwith from the island of Sicily, and its possible invasion by the fighting forces of the United Nations, makes it opportune to review in brief what proportion of her domestic mineral raw materials Italy would lose if the island were wrested from her. The principal raw material to be cut off would be sulphur, as the island, with an annual output of about 250,000 tons of sulphur, accounts for, in normal times, nearly three-quarters of the entire Italian production, or about one tenth of the whole world's output, of this important chemical. The deposits, probably connected with the volcanic phenomena of Etna and Stromboli, occupy some 5000 square miles in a belt extending from Mt. Etna in the east, westwards towards Agrigento, and the principal mines are located near Caltanissetta, Enna, and Agrigento. In addition there is a not in-

considerable deposit outside this area in the Palermo district. The sulphur is exported mainly through the ports of Licata and Catania though a certain amount is also shipped from Porto Empedocle. In the south-eastern part of the island, in the Ragusa district, are the well-known deposits of asphalt; these are especially important to Italy since the higher grade material can be distilled for oil. Lower grades, usually those with under 6 per cent. bitumen content, are used for road-surfacing, etc. Although these deposits are responsible for rather less than three-quarters of all Italian production of asphalt, the contribution of some 2000 tons of crude oil annually which they make to the Italian war effort, is, of course, a mere drop in the bucket. About one-seventh of Italy's output of rock salt is produced in Sicily, chiefly near Agrigento, and about three-quarters of this was formerly exported to the mainland. Solid fuel is a serious deficiency in the island, although occurrences of lignite, albeit of an uneconomic grade, are actually known to exist near Messina. Other Sicilian mineral products include a large quantity of gypsum and the famous pumice stone and pumice powder from Lípari, but the only metals mined are a trifling amount of manganese and antimony.

Titanium for Zinc Plate

TWO American chemists, Robert M. Burns and George W. Jernstedt, have found that a small percentage of titanium improves the corrosion resistance of zinc plate. Their discovery, in view of the degree of chance connected with it, falls into the same category as that of saccharin and the first aniline dye, to judge from the description given in the May *Chemical and Engineering News*. The two chemists, who work for Westinghouse Electric and Manufacturing Co., were seeking a chemical pre-dip which would confer upon the metal sheet the same acceptance of phosphate treatments as is obtained with mechanically polished samples. (For some reason a highly polished plate, after phosphating, will make a firmer paint bond and therefore has a greater resistance to corrosion than unpolished specimens). Months of research had yielded no useful results until one day Mr. Jernstedt happened to dip zinc plate into a solution of disodium phosphate. After receiving the usual commercial phosphate treatment, the plate gave an exceptionally good performance when subjected to the salt-spray and steam-chest tests. But when the same process was repeated with more zinc plate the investigators failed to duplicate their success. Further tests, however, showed that there was one bottle of disodium phosphate in the laboratory, and one only, which gave good results, and it was from this particular bottle that the original sample of phosphate had been taken. The spectroscope showed that the sample contained a trace of titanium. The chemists then tried the addition of this element to other samples of disodium phosphate, but here again they had no luck.

The Edison Touch

THERE was only one logical step left to them now, so, taking their lives in their hands, they rang up all the chemical manufacturers they could think of and asked them what was the titanium content of their chemically pure chemicals! (What a pity that Edison is not still alive; it would have been a search after his own heart). The manufacturers were flabbergasted but helpful, and in the end a method of making phosphate contaminated with titanium was traced. At present the concentration of titanium in the salt is 0.001 per cent., and only a 1 per cent. solution of this disodium is used as a pre-dip. In production, the metal pieces, on a chain conveyor, pass through the pre-dip in ten seconds. From there they go directly to the usual commercial phosphating bath, after which comes the spray painting or lacquering. Samples so treated will withstand 200 hours of salt spray or steam chest without any corrosion. Why the titanium gives such protective action is still a mystery.

The Peruvian Government has established an official register of industrial chemists under the Ministry of Development (Fomento) in order to safeguard the interests of both chemists and industry. Commercial firms have sent lists of their technical personnel, giving nationality and salary, to the Ministry and, henceforward, the register will be kept up to date by means of yearly returns. In future foreign technical experts will have to pay 500 gold pesos registration fee before they can act in their professional capacity.

The Electron Microscope

Will Molecules become Visible ?

ONE technical dictionary, which defines the microscope as an instrument "so constructed as to magnify objects larger than one five-thousandth of a millimetre," will have to make a substantial alteration in its paragraph on microscopy for any future edition. The advent of the electron microscope into the field of practical research instruments has indeed revolutionised microscopy. In a recent radio talk Sir Charles Darwin pointed out that with the light microscope though you can magnify the image indefinitely you gain nothing by it beyond a certain point, as the result is only a large blurred image instead of a small blurred image. The limitation to the light microscope is imposed by the wave-length of the light used; the wave-length of visible light used in the ordinary microscope is about one five-thousandth of an inch, and any attempt to magnify any object of that order of size is doomed to failure. Ultra-violet light and X-rays have wave-lengths shorter than that of light that is visible to the human eye, and the range of microscopy has been much extended by their use. Now the range has been further increased by the development of the electron microscope. If the only limitation of this new instrument depended on the electronic wave-length, it would be possible eventually to design an instrument enabling us to see individual atoms. But, as Sir Charles Darwin has said, there is another limitation which is not so fundamental, but which threatens to be practically more serious: it seems that no "lens" for focussing the electron beam can be so designed that it will enable us to see an object more than a hundred times smaller than the size of the smallest object that can be seen under the ordinary microscope. The best electron micrographs so far obtained have provided magnifications of the order of 20,000 times, though a few good ones have resulted at magnifications as

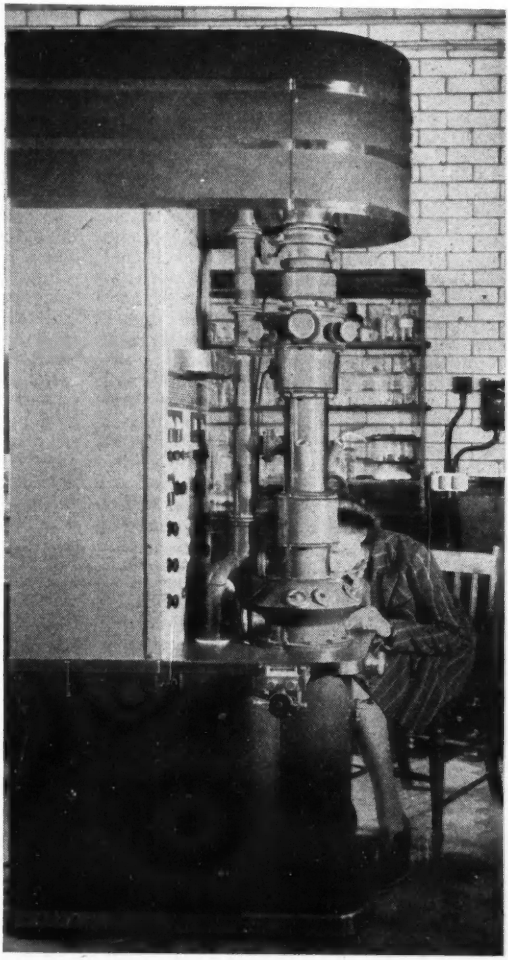


Fig. 1. The R.C.A. electron microscope at the National Physical Laboratory.

great as 100,000 times, or nearly so. The earliest practical work on the electron microscope was done in Germany ten years or so ago. The best known commercial instrument is that perfected by Dr. V. K. Zworykin and his associates in America. (Fig. 1). Marketed by the Radio Corporation of America, at least six instruments of this type have been sent to Britain under the Lease-Lend arrangement.

Probably the most interesting discoveries made with the electron microscope are those arising from the examination of microbes and viruses. In his radio talk Darwin said, "There were many diseases known to be caused by microbes which were too small to see at all, but now we can see them. I have seen one beautiful photograph made in Germany, which shows the mysterious thing called bacterjophage, a beast which attacks and kills bacteria. You can see a large black object, the bacteria, and a crowd of things like tadpoles round it swimming towards it and attacking it Without the electron microscope they were simply not seen at all. We have also ourselves made photographs of those other mysterious things called viruses which cause certain kinds of diseases. Altogether, I think we can be pretty sure that in quite a few years a great deal more will be known about disease."

An interesting article describing the results obtained by applying the instrument to chemical studies has been written by Dr. V. K. Zworykin in *Ind. Eng. Chem.* (1943, *35*, 4, p. 450). A considerable amount of research has been done using the microscope to examine dusts and smokes which may have industrial importance if found suitable for use as preservatives, pigments, insecticides, chemical reagents, and catalysts. In addition certain kinds of dust constitute serious health hazards. Dr. Zworykin mentions carbon black as being one of the most interesting smokes from the microscopic point of view. Produced by the partial combustion of natural gases, a highly non-homogeneous collection of carbon particles is seen under the electron microscope when no precaution is taken to derive all the carbon from the same portion of the flame. The carbon black derived from a wax taper (Fig. 7) or from a camphor flame, on the other hand, has a highly homogeneous distribution; the individual particles are more or less of uniform size and about 0.000002 in. in diameter. Particles in most metal smokes have characteristic shapes that reflect their crystal structure. Particles of zinc oxide prepared by burning zinc in an oxidising flame, for instance, consist primarily of four fine spikes joined together at the centre (Fig. 6), and they deviate in form from those of zinc oxide pigment.

Frequently, an electron micrograph of a sample indicates directly the reason for its possessing peculiar physical or chemical properties. Thus a certain batch of calcium carbonate that showed unusual chemical activity was found to consist of particles which appeared strongly corrugated or even porous, indicating an

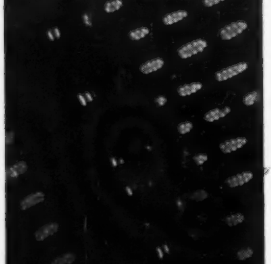


Fig. 2. A diatom, *Nitzschia sigma*, magnified over 10,000 times. Note structure revealed in each pore.

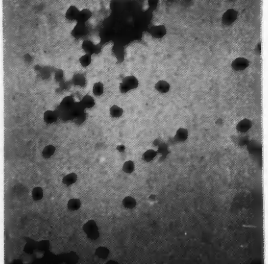


Fig. 3. The small oblong bodies are the vaccinia which produce immunity from smallpox. × 8000.

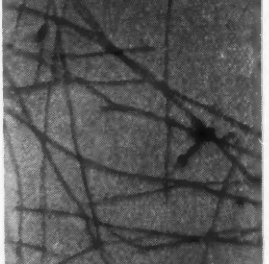


Fig. 4. The virus responsible for a specific tomato disease is seen to consist of long threadlike particles. × 25,000.

Fig. 5. Magnesium oxide smoke consists of aggregates of small cubic crystals. × 8000 approx.

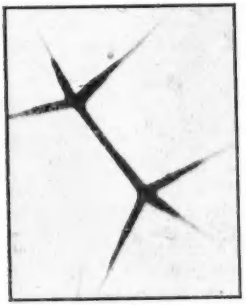


Fig. 6. Typical particle of zinc oxide smoke. The finest fibres are said to be no more than 50 atoms thick. × 8000 approx.

Fig. 7. Carbon smoke from a wax taper. The microscopic particles form long chains. × 8000 approx.

unusually large surface area. Again, two lots of lead arsenate, which differed greatly in their effectiveness as insecticides, were examined under the microscope; it was then found that the first sample, which had proved an excellent insecticide of great covering power, was made of particles in the form of extremely thin small plates; the second less effective material consisted of relatively thick granular particles.

In many pharmaceutical preparations, too, fineness of division and surface area are factors of great importance. The individual particles in the colloidal suspensions used in pharmacy are generally far too small to be distinguished by a light microscope, but the new instrument makes their shape and size visible.

A field of constantly increasing importance is the chemistry of organic polymers, such as plastics and synthetic rubbers. While little can be said about developments in this field at present, it appears certain that the electron microscope will prove a valuable aid in the study of these materials. Fig. 8 shows slightly polymerised vinyl chloride such as is used in the manufacture of hemp rope. In the same material, when fully polymerised to form the artificial rubber Koroseal, fine dark specks are clearly visible at magnifications of the order of 100,000 times, and these are small enough to make it probable that they are to be considered as constituting single molecules.

It is interesting to learn from Zworykin that the instrument is ideally adapted for the taking of stereomicrographs, owing to its extraordinarily great depth of focus; this point is in striking contrast to the fact that three-dimensional representation is impracticable with high-power light microscopes, because the latter have so small a depth of focus that the required inclination of the object would tend to blur the image except within a very narrow range. The stereomicrographs obtained with the electron microscope give a striking impression of depth. Another useful feature of the instrument is the adapter by which it can be converted into a high-precision diffraction camera for the determination of the crystalline structure of materials. The spacing and relative orientation of neighbouring atoms in the crystal lattice can be determined by this means with an accuracy within three per cent.

The problem of examining the surfaces of opaque specimens—a technique which is particularly useful to the metallurgist—has now been solved successfully, although *direct* observation with the electron microscope is quite impossible. Two techniques have been worked out, however, which make use of the high resolving power obtainable with electrons in the study of opaque specimens such as polished and etched metallographic sections. The first involves the preparation of a plastic replica of the surface—a cast—which is thin enough to transmit electrons readily. A procedure which has given satisfactory results requires an initial evaporation of silver on to the surface *in vacuo*. The silver coating,

bearing the negative imprint of the surface, is then pulled off and a collodion solution flowed over the face of the mould which came in contact with the surface we wish to investigate. When the collodion has dried the silver may be dissolved off with nitric acid and the positive collodion replica is left. Fig. 9 shows an electron micrograph of fine pearlite structure in steel obtained from such a cast; the detail is sharp and perfectly resolved, whereas under an oil-immersion light microscope the structure is only partially resolved, being considerably beyond the limit of resolution of any light microscope. It is clear that the electron microscope, in conjunction with the replica technique, represents a considerable advance over the metallographic microscope in the resolution of fine surface detail. The second technique uses a basically different type of electron microscope, which depends upon a scanning method comparable to that used in television. With this instrument pictures have been obtained with resolutions of the order of 0.000002 in., which is considerably better than can be attained with the light microscope, and useful micrographs have been obtained of metallic surfaces.

The photographs which illustrate this article were all taken with the large R.C.A. instrument that stands nine feet tall; the working column is about a foot in diameter, and altogether the instrument covers a floor space of about three feet square. Smaller electron microscopes are already being made in

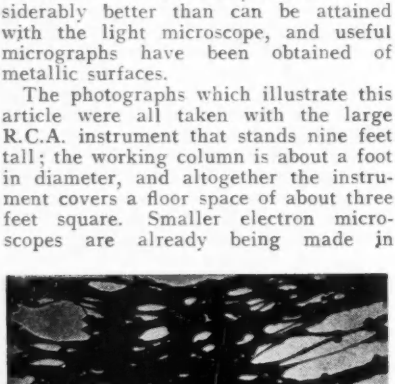


Fig. 8. Slightly polymerised vinyl chloride. × 10,000.

America and these should prove useful in commercial practice. R.C.A. have found that in the study of colloids, viruses, and macromolecules in particular a fixed magnification and a relatively low operating voltage, giving large contrasts, have proved satisfactory. The compact

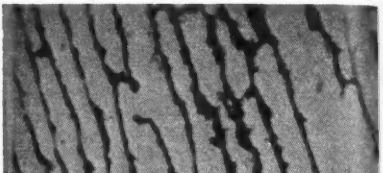


Fig. 9. Pearlite structure in steel. Micrograph obtained from collodion cast of original metal surface. × 16,000.

and simple "desk model" instrument made by this firm has a microscope column in which there are only 16 inches between the electron source and the fluorescent screen. The magnification is about 5000 times, and the resolving power is such that subsequent enlargement of electron micrographs by as many as twenty times is needed to bring out all the detail present in the negative. Another convenient instrument is the mobile microscope perfected in the electronics laboratory of America's General Electric Company. Capable of magnifying objects 10,000 times, it differs from earlier electron microscopes in applying electrostatic focussing to the beam of electrons instead of electromagnetic focussing.

This model has an overall height of 52 in., and requires floor space of about 2 ft. by 3 ft. The cabinet includes the power supply, the mechanical vacuum pump, and an air-cooled, oil-diffusion high vacuum pump. A camera is provided for mounting on the front of the instrument.

ACKNOWLEDGMENTS

Figures 1-7 were prepared from photographs made in the Metallurgy Department of the National Physical Laboratory, and are reproduced by courtesy of the Director of the Laboratory. (Crown copyright reserved). 'Acknowledgment for Figs. 5-7 is also made to the Editor of *Monthly Science News*, and for Figs 8 and 9 to *Industrial and Engineering Chemistry*.

B.C.U.R.A. New Laboratories

Opened at Kingston by Sir Edward Appleton

THE new physico-chemical research laboratories of the British Coal Utilisation Research Association were formally opened on Wednesday last week by the secretary of the D.S.I.R., Sir Edward Appleton. These laboratories, at Coombe Springs, Coombe Lane, Kingston-on-Thames, have been erected to replace those at Fulham, which were destroyed in an air raid.

The president of the council of the B.C.U.R.A., Sir Evan Williams, took the chair at the opening ceremony. He said that his association was grateful for all that Sir Edward Appleton and his department had done to help the association during its first five years. The association's actual income had risen from £25,000 in 1938, to £75,000 in 1942. The beginning of the second five years saw the association enjoying financial arrangements with the coal industry and the Government (through the D.S.I.R.) which would permit the creation of a fund of £1,000,000 to be spent on coal utilisation research during the next five years. Some people might think that this sum, substantial though it was, should have been still greater. But research, particularly in time of war, took time to organise and develop; even millions of money could not create it as easily or rapidly as a cheque could be signed. There were all sorts of problems of personnel, of staff, and of accommodation to be taken into consideration. The association was satisfied that it had adequate resources for the tasks immediately confronting it, and confident that when it needed more money and showed the results of the work already undertaken, that money would be forthcoming.

Half-way House

The Coombe Springs laboratories would not be the permanent home of the B.C.U.R.A. A site of twenty acres had been acquired at Leatherhead and the permanent research station would be erected there. In the meantime there was urgent work to be done, and they had therefore set up this "half-way house" so that their research workers might get on with their urgent tasks.

Sir Evan went on to say that it was astonishing how comparatively little was known about the nature of coal; by that he did not mean the enormous range of products that could be extracted from it, but the structure and behaviour of the mineral itself. The B.C.U.R.A.'s problem as a research organisation—ultimately it was also the national problem—was to find and practice methods of utilising coal with the maximum economy and efficiency consistent with the requirements of industry and of the general public. A recent survey showed that 73 per cent. of the people in this country wanted open coal fires or coal ranges. Those fires, and also the cooking and hot water appliances, needed to be efficient, economical, convenient and simple to operate and clean, and practically smokeless. The B.C.U.R.A. thought it had the solution of that problem. Notable progress also had already been made in solving the problems connected with coal combustion in industrial furnaces, but there was a great deal more to be done in that direction.

Gas producers for road transport had been brought to the stage where they gave highly satisfactory and competitive results under strict tests and operative conditions on the road. In activated coke there had been found, they thought, the fuel of the future for road transport.

Rapid Development

Sir Edward Appleton began his speech by congratulating, on behalf of the D.S.I.R., the council and members of the B.C.U.R.A. both on their new laboratory and also on the recent financial growth of the association to its present imposing stature. He continued, "I believe that this is one of the first notable signs of a great forward movement in the growth of scientific and industrial research which I expect to be one of the features of post-war Britain. It is surely a significant sign when one of our oldest industries—the coal industry—shows a youthful and energetic attitude in applying science to its own needs. And why can we report such satisfactory progress to-day? Largely, I think, for two reasons. In the first place because this research association is a fully co-operative organisation in that coal producers, coal distributors, manufacturers of coal-using appliances and coal consumers have realised their common interests. Secondly, because the coal industry, with far-seeing vision, has succeeded, with Government assistance, in placing the association in a strong financial position."

Proceeding, Sir Edward said that although this research association was really a very young organisation, it had made up for its lack of years by the striking rapidity of its growth, due largely to Sir Evan Williams, whose untiring effort in engendering the co-operative spirit had been the greatest single factor in securing the favourable position now enjoyed by the research association. The question whether the British effort on research was commensurate with our industrial needs, he felt sure had to be answered in the negative, but to talk merely of spending more money was not enough. The attack on both new and old problems must be planned and, most important of all, some of our best scientific brains in the country must be attracted to solve them.

Personal Notes

The honorary degree of Doctor of Science was conferred on DR. J. V. N. DORR by Columbia University, New York, on June 1.

MR. GEOFFREY HEYWORTH, chairman of Lever Brothers and Unilever, Ltd., has been appointed a member of Mr. Justice Cohen's Board of Trade committee which is to examine company law.

DR. W. E. LE B. DIAMOND, who has been assistant secretary of the Institution of Gas Engineers since 1937, has been appointed general manager of the British Plastics Federation.

DR. FRANK B. JEWETT has been re-elected president of the U.S. National Academy of Sciences for a further term of four years. British scientists who become foreign associates of the Academy include SIR HAROLD SPENCER JONES and DR. R. V. SOUTHWELL.

The honorary degree of LL.D. of Glasgow University was conferred last week on DR. C. H. DESCH, F.R.S., scientific adviser to the Iron and Steel Research Council, and DR. T. S. PATTERSON, emeritus professor of organic chemistry, University of Glasgow.

MR. S. MARGISON and MR. F. A. WALKER have retired from the committee of the Manchester section, Oil and Colour Chemists' Association. Their successors, elected at the section's annual meeting on July 2, will be announced shortly.

The new officers of the Canadian Chemical Association were introduced at last month's meeting at Montreal. They are DR. R. R. MCLAUGHLIN, University of Toronto, president; DR. CYRIL WATSON, Dominion Experimental Farm, Ottawa, vice-president; DR. A. LABRIE, Quebec Ministry of Fisheries, hon. secretary; and DR. C. M. JEPHCOTT, Department of Health, Toronto, hon. treasurer.

The Society of Chemical Industry has elected as honorary members ACADEMICIAN ALEXEI BACH and DR. TE PANG-HOU. The former, who is well known for his biochemical researches, was responsible for establishing with the help of PROFESSOR ZBARSKY the chemical institute named after Karpov, of which he is now director. In 1920 he started the Biochemical Institute under the People's Commissariat for Health. He was born in 1857. Dr. Te, who is 53, was born in China. After obtaining his B.Sc. at the Massachusetts Institute of Technology and his M.A. and Ph.D. at Columbia University, he returned to China in 1921 to become chief engineer of the Pacific Alkali Co. at Hopei. His "Practical Treatise on the Manufacture of Soda" is a standard work on the subject.

I.C.I. Overseas

Australian Company's Report

THE profit of Imperial Chemical Industries of Australia and New Zealand, Ltd., for the year to September 30, 1942, after providing for taxation, was £363,818, compared with £347,043 in 1941. A dividend of 5 per cent. on the ordinary shares has been declared, and £100,000 has been transferred to general reserve. In view of expenditure involved in expansion of the company's activities, shareholders agreed to capitalisation of the ordinary dividend.

Industrial activity for war purposes has meant a steady demand for the company's products. Additional chemical manufacture for war purposes has been undertaken at the request of the Government. Steps have been taken in connection with the manufacture of polyvinyl chloride and formaldehyde, for which full technical information is being supplied by the parent company. Two associated companies have increased their range of manufacture. Production of phthalic anhydride and beta-naphthol has been started by the Newcastle Chemical Co., while Albright and Wilson (Australia) are completing the erection of phosphorus and amorphous phosphorus plants. During the year the manufacture of nitrobenzene and paranitrochlorbenzene had been undertaken; other new products for which plants were in course of erection were aniline, diphenylamine, phenothiazine, trichlorethylene, carbon tetrachloride and rubber chemicals. The technical resources of I.C.I. had been available and fully utilised in those new projects.

DERBYSHIRE STONE

In the course of his speech at the annual general meeting of Derbyshire Stone, Ltd., the chairman, Mr. S. D. Clements, remarked that the company had been producing to the limit of its capacity and had certainly given of its best. In so far as limestone powder was concerned, the large quantities supplied during the past year must have been most helpful in producing the large additional supplies of home-grown food which had been so necessary to the successful continuation of the nation's war effort. In addition, the mining and refining of fluorspar, an activity developed by the company only since the start of the war, was now completely established, and it could be stated that the company was one of the three largest producers of this important mineral in the country to-day. The recently-acquired basalt quarrying business of Hardamac, Ltd., carried on at Taddington, near Buxton, had fully realised their expectations and might well become of still greater value.

Metallurgical Section

Published the first Saturday in the month

Metallurgical Section

July 3, 1943

Reclaiming Tin from Scrap Brass

Large Scale Operation an Essential

by A. G. AREND

NEED for recovery of small percentages of tin from brasses and other copper alloys has become more acute to-day in view of the current shortage of tin. A survey of statistics of the great tin-producing countries of the world shows that the bulk of the metal previously hailed from the Federated Malay States and the Dutch East Indies. The output from these States, together with that from Siam and China, amounted to two-thirds of the world's production, while in certain years the proportion was even higher. According to the American Bureau of Metal Statistics, the world's total production in 1936 was 177,879 tons, of which these four countries alone accounted for 120,985 tons. This figure does not include the output of Burma, which amounted to a further 4270 tons. Almost all of this supply appears to have passed into enemy hands, and, unfortunately, there is no really appropriate substitute for tin, despite all endeavours to find one.

Problems of Recovery

Among the chief consumers of tin are tinplate makers, while with brasses, gun-metals and other copper alloys, a comparatively large consumption is also evident, but in order to understand the subject properly the matter has to be seen in its true perspective. White bearing alloys contain anything from 60 to 80 per cent. of tin, but the total tonnage does not compare with that of the corresponding copper alloys, which on an average may not contain much more than some 1 to 2 per cent. of this metal. The reason for this is not so well seen here as in the U.S.A., where the vast automobile industry makes such enormous demands on different brass alloys. Just as the numerous patentees found practical difficulties in working out their proposed schemes, when attempting to recover tin economically from tinplate, so also did others, to an even more extreme extent, in connection with the tin contained in copper alloys. Many of the recovery patents taken out for tinplate had evidently not bargained for the very small content available from the modern electrolytically prepared sheets, nor for the bulky disposition of the widely divergent makes of canisters, etc., which involved much unexpected labour. It is no exaggeration to say that the vast majority of proposed processes for the reclamation of tin from tinplate were never continued on the large scale. The same remarks apply to the recovery of tin from brasses and similar alloys which necessitates a more complicated form of treatment. There is no simple "dissolving-off" process permissible, as in the case of tinplate, while the presence of small percentages of tin with large proportions of copper invariably presents a more complex problem. Direct smelting methods were considered so complicated in earlier years that a point was made of separating all scrap material rich in copper, and keeping it apart from tin material as far as possible.

A fresh development arose in the U.S.A. because of the vast quantities of scrap radiators and other copper alloy parts. Instead of being handled by small scrap-metal refining firms, these were dealt with by large ore-smelting concerns as a huge subsidiary undertaking, in which keen competition existed. No such conditions exist in this country, because the tonnage of scrap alloys is relatively small. Many of the small metal refiners here are left with brass alloys on their hands, since there is no immediate need for their particular composition, and the necessary plant for individual separation of the component metals is not available. This means that an appreciable proportion of tin is held up indefinitely at a time when it is vitally necessary. The subject is made more acute because Government and Admiralty specifications usually demand pure or electrolytic metal only in their alloys, in order to ensure perfect physical standards.

Smelting in Conjunction with Copper

In order to recover tin economically from copper alloys, it is almost essential to operate on a large scale; hence the advantage of simultaneously smelting with ores and thus recovering all products at the one time. Instead of having to debit costs against the tin which is so obtained, it is thus recovered as a by-product to the point where it accumulates in the fume. Small metal refiners are not in this happy position, and any attempts at reclaiming the tin might be exceedingly

uneconomic. The subject is too large to be dealt with shortly, and the following is a brief résumé of the system involved. In the first place, it is necessary to have blast furnaces, settlers and converters, etc., while all fume evolved has to be led off to efficient electrostatic precipitators, complete with the accompanying cooling systems. All copper ores, residues and concentrates, from different mining pursuits are first smelted in the blast furnace to form a matte, plus slag. This is most economically performed where a matte of comparatively low copper content will suffice, *i.e.*, from 35 to 40 per cent. copper, as the slags are correspondingly low in copper, and foul slags which necessitate re-smelting are very infrequent. Mattes containing as little as 18 per cent. copper ensure an almost perfectly clean slag every time, but the fuel consumption is not reduced. It does not do to criticise the concentration of copper in different mattes as prepared under different smelting conditions from widely varying ores, since what may be highly economic by one system, may not be a paying proposition with another.

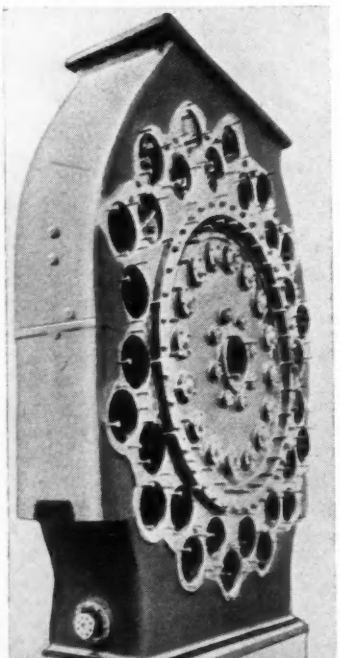


Fig. 1. Blower equipment for giving the maximum blast from the minimum space.

As a general rule, however, the richer the matte the better, but with the presence of much scrap copper alloy material this can be assured without risking the enrichment of the slag. Instead of concentrating this matte to regulus of some 70 per cent. copper by an intermediate roasting process, as was formerly done, all scrap brass material is added prior to treatment in the converter. This is most conveniently done by having a settler at the side of the blast furnace, into which the molten matte is run and retained until space is available in the converter. In some of the large American smelter outfits, the settler is dispensed with, and loads of scrap are directly dumped into the converter before putting on the blast.

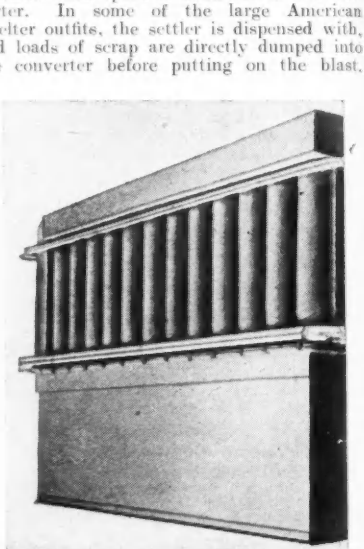


Fig. 2. Box-shaped structure in which the collectors are housed.

As the chemistry of ordinary blast smelting and converter work for copper is well known, it need not be repeated, but it has to be noted that the presence of much zinc from the brass varies the conditions. Much attention has to be devoted to the design and construction of the blower equipment used, and this has been considerably improved of recent years. The blower is best seen when opened up for repair or replacements, and, although of comparatively simple construction, it is expected to provide the maximum air blast from the minimum of space, and to function for lengthy spells of continuous service. Blast air is required to operate both blast furnaces and converters, and to ensure that the fume removed is appropriately carried through the flues to the condensing and electrostatic precipitation departments. Despite the amount of heat present, it is necessary to have the settler fired indepen-

dently. It receives the matte, and is a convenient medium for the charging-in of car radiators, and other copper alloy scrap. From the settler, the enriched matte or regulus is run into the converter, where the air blast causes the impurities contained in the brass, apart from the iron present, to be removed. The blister copper so obtained is run into moulds, and eventually cast as anodes and electrolytically refined.

The process of copper refining thus proceeds irrespective of how much scrap metal has to be dealt with, as the cycle of operations is not restricted in any way by the tonnage which comes to hand, so that the conditions are particularly favourable for fluctuating scrap acquisitions. No such conveniences are available to small metal refiners who are faced with the alternative of either burning much unnecessary fuel, or temporarily shutting down their furnaces.

Reactions and Recovery of the Tin

The path of tin through this process reveals that, despite the very small percentage present, which frequently does not exceed 1 per cent., all of it is completely recovered. Although the majority of tin is removed during converter treatment, what little remains in the metallic copper is reclaimed as an anode sludge during subsequent electrolysis. In the converter, tin is not only removed because of the oxidising conditions but also, in presence of the sulphur of the matte, forms the volatile sulphide of tin. Apart from this, the fact that so much zinc is being oxidised in any case means that fine particles of tin are entrained and carried off mechanically. Thus tin is caused to pass off from the converter from three different sources, and only very minute quantities usually appear in the anode sludge if the process has been properly operated.

Antimony reacts in much the same manner as does tin, and so also in some respects does arsenic. The fume evolved is mainly composed of zinc oxide, but may contain anything up to 12 per cent. of lead oxide, in accordance with the quality of the scrap brasses which have been included. Iron is principally oxidised, and removed in the converter slag. Any nickel present remains with the copper, and is separated during electrolysis. Bismuth is also largely retained in the copper and is recovered similarly, but cadmium passes off with the fume.

The fume thus comprises from 1 to 3 per cent. or more of tin, usually less than 1 per cent. of antimony, a few tenths per cent. of cadmium, 0.5 per cent. iron oxide, up to about 3 per cent. of copper oxide, 12 per cent. of lead oxide, and the remainder zinc oxide. It should be understood that the tin content varies very markedly, and on occasions has been known to exceed not more than 0.5 per cent. On the other hand, the vast tonnage of scrap metal passed through the process must not be underestimated, and the total content of tin so recovered amounts to an appreciable figure.

The fume which is evolved alike from blast furnace and converter is first passed through cooling towers, which are set up in batteries

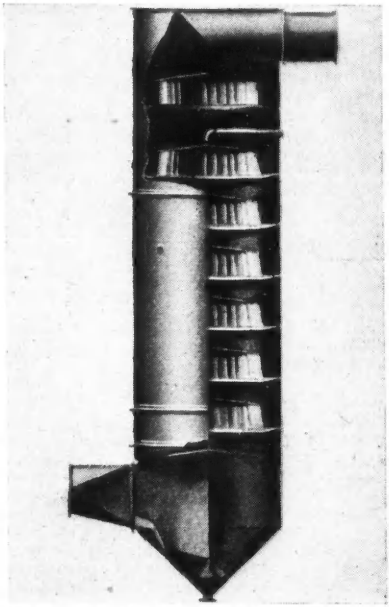


Fig. 3. Interior of a Schneible wet dust collector sometimes used for collecting instead of the electrostatic precipitator.

of considerable numbers. These usually take the form of tall cylindrical constructions, mounted in a box-shaped building, and are individually composed of a number of impingement plates. Small refiners have been known to depend on wet dust collectors alone without the assistance of electrostatic precipitators, but in some instances these involve more manual attention when used separately. The cooled fume can be deposited as a wet sludge, but the electrostatic process precipitates it continuously and automatically in the desired dry condition. As the bulk of the material comprises zinc oxide in the form of fine dry powder, it is in demand by the makers of lithopone, and it is despatched from the precincts of the smelting works to the large paint manufacturers, who digest it in dilute sulphuric acid for the production of zinc sulphate. The insoluble residue remaining is composed of lead sulphate together with the tin, mostly in the condition of oxide, and is returned by arrangement with

the smelters. In other words, the paint makers only get the use of the fume to extract the zinc content. The insoluble sludge contains almost the whole of the tin recovered from the scrap brasses, etc. During the lithopone process, metallic zinc dust is added to precipitate copper from the solution, and hence there is no danger of any tin or metals other than zinc remaining in solution. The sludge is dried, mixed with a little fine coal, and reduced to a crude tin-lead alloy containing variable proportions of antimony, copper, etc. It is cast into anode plates and electrolysed, so that pure tin is recovered in the form of sheets, which are stripped off, and either sold in this condition or melted down to bars.

In reviewing the subject, it will be noted how at no point is there a possibility of loss of tin, while a source of tin thus becomes available which would otherwise be locked up in the form of alloys; and the latter at present, because of the demand for pure electrolytic constituents, enjoy only a very limited consumption. It should be made clear that the foregoing work relates to occasions when there is a large surplus of copper ores available; for dealing strictly with scrap alloys alone, direct electrolytic separation is most satisfactory, but necessitates a source of cheap current. The reason for this is that the varying tin content in the electrolyte causes wide voltage fluctuations without improving the deposition, and hence adds materially to the costs without increasing the output.

Utilising Gold Residues

South African Waste Ferric Oxide

ECONOMIC use of the residue dams and dumps left by the gold workings of the Witwatersrand has been advocated by Dr. A. H. White, consulting metallurgist to the Union Corporation, Ltd., in a paper presented to the Mining and Metallurgical Society of South Africa and the Witwatersrand University and recorded in the *South African Mining and Engineering Journal*. In 1940, Dr. White points out, the reduction works of the Rand crushed 64.5 million tons of ore, of which a conservative estimate of the pyrite content would be 2.5 per cent. FeS_2. At present this material is gradually undergoing oxidation in the sand dumps and much more slowly in the residue dams. Ignoring a somewhat prolonged stay in the form of basic ferric sulphate, the final products will be ferric oxide and sulphuric acid in accordance with the equation:

$$2FeS_2 + 4H_2O + 15O = Fe_2O_3 + 4H_2SO_4,$$

which shows that one ton of pyrite produces 1.635 tons of sulphuric acid, and this would require 0.933 tons of lime for neutralisation. The 1.7 million tons of pyrite dumped would thus require 1.5 million tons of lime, or £4.5 millions per annum to neutralise its oxidation products completely, which means 1.4s. per ton of ore, or 56s. per ton of pyrite.

Source of Superphosphate

Better use might be made of this material. About 2 per cent. would probably be recoverable in a sufficiently concentrated form by flotation at a cost of approximately 6d. per ton of ore. Flash roasting would cost less than 2s. per ton of pyrite, so that isolation in a form suitable for further gold extraction would cost about 27s. per ton of concentrate; adding a further 1s. per ton for this purpose brings total cost to 28s. per ton with a recovery value of possibly 24s. per ton or more.

Up to this point only a loss is probable, but in roasting the 1.7 million tons pyrite the SO_2 evolved could be easily converted in suitable plants to 2.7 million tons of sulphuric acid, and in its turn this could be converted into 7 million tons superphosphate for which a suitable market does not, but should, exist, said Dr. White. There is a general lack of phosphate in South African soils which has largely accounted for the low crop yields obtained. The Orange Free State is about the same size as North Carolina. In 1925, the former used 8000 tons of fertilisers and the latter 1,250,000 tons. One ton of fertiliser is reckoned to produce seven tons of return freight in the form of additional crops.

Government Aid Desired

It is evidently to the Government to whom we should look, Dr. White concluded, for the capital required for these purposes. It is the high cost of local sulphuric acid which explains why our known deposits of phosphate rock are not being exploited nor our potentialities properly explored. The present proposal suggests the provision of large supplies of cheap acid which has numerous other uses as well. In this manner the debit of 56s. per ton of pyrite can be converted into a profit nearly as great, especially if we take into account the potential value of the treated ferric oxide as a rich iron ore.

A Chamber of Mining has been set up in Argentina for the protection of mining and metallurgical interests, and to promote a mining school for the training of mining experts. The president and the majority of its members must be Argentine-born, but the chamber will also include five naturalised Argentines or foreigners.

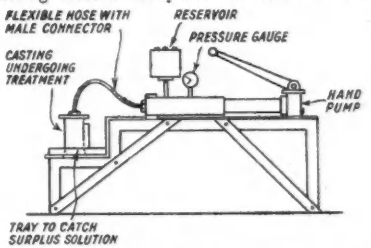
Salvage of Porous Castings

A Valuable War-Time Service

ESPECIALLY nowadays, when material is in short supply, it is essential that wastage of castings due to porosity be reduced to the minimum. Where castings are intended for use at high pressures and temperatures, it becomes a costly matter to scrap such material because of porosity and consequent weeping of the fluid used for conveyance through the casting. Fortunately, however, there is now no need to scrap all this material upon which expensive labour charges have been incurred for machining, since a method is available which has been thoroughly tested by Commercial Structures, Ltd., and is now in operation at their Leyton works, in collaboration with Bakelite, Ltd. The method is capable of rendering serviceable a very large percentage of porous castings, which hitherto would have been returned to the melting pot.

The process is simple and consists in subjecting the castings to a treatment with Bakelite sealing solution under moderate pressure in order to ensure that all pores are sealed. They are then given a controlled heat treatment in an oven and, after cooling, are tested to the specified test pressure. The Bakelite within the pores of the metal is quite insoluble in water, petrol, oil, alcohol, and other solvents. It resists steam even at high temperature. In cases of severe porosity it may be necessary to apply a second complete treatment. Two grades of special sealing solution are available. For fine porosity a clear fluid (V.1845) is used, and for severer porosity a solution (N.2106) containing a filler.

The apparatus for impregnating the porous casting with plastic material consists of a pressure pump, developing 5000 lb./sq. in., and a cylinder fed with plastic material from a reservoir. The action of the pressure pump forces the plastic from the cylinder into the casting undergoing treatment. A gauge mounted on the cylinder records the pressure. After the process is completed the casting must be subjected to heat treatment



in an electric controlled furnace in order to harden the plastic. The heat should firstly be controlled at 85° C. until the solvents are removed; after which the temperature should be controlled at 110° C. for one hour and finally raised to 135° C. for one hour.

After treatment, test pressures can often be applied and maintained up to 8000 lb./sq. in. on castings which are strong enough. The casting can then be removed and cleaned out with thinnings. The treatment is equally applicable to ferrous and non-ferrous metals, including the light metal alloys. This method of salvage should be of particular interest to firms who specialise in high-pressure and temperature apparatus or where the nature of the medium flowing in the systems causes external deposits of dirt or salts due to weeping or seepage through porous castings, valves and pipe-lines. In order to speed the war effort, Messrs. Commercial Structures, Ltd., are prepared to demonstrate the process to interested firms, to educate their staff, and, if necessary, to treat castings within the limits of the company's plant.

TRANSFORMATION OF TIN

The transformation of white tin into the grey form is discussed in *Metal Industry* (1942, *60*, 22, p. 364). Grey tin and ordinary tin are different forms of the same element. They have the same chemical composition, but grey tin has a specific gravity of 5.75 as compared with 7.3 for white tin. Grey tin changes back to the white form on heating. The temperature of transition from white to grey tin is 13.2°C., but there is always a considerable undercooling effect. In practice, unless the tin has been "inoculated" by contact with grey tin, the change does not take place until the tin is exposed to much lower temperatures. Indeed, very few cases have occurred where commercially pure tin has been affected in service, even in cold climates. This is due to the inhibitive effect of traces of impurities in the tin, as well as to the undercooling effect. Bismuth and antimony are particularly effective in preventing the change, even at very low temperatures, and traces of both these metals occur in most commercial brands of tin. Lead also tends to prevent the change, zinc and aluminium to accelerate it, but neither of these metals is a common impurity of tin.

Indian Metal Research

Mines and Metal Salts Examined

FURTHER details from the annual report for 1941-42 of the Director of Scientific and Industrial Research, India (*see* THE CHEMICAL AGE, June 19, p. 649), deal with the investigations of the metal resources of the sub-continent, many of them as yet almost untapped.

The metals committee has made recommendations on the manufacture of magnesium, the establishment of a spelter industry in India, the need for producing ferro alloys and the reopening of old copper, zinc and lead mines. Other problems investigated include the extraction of thorium from monazite sands, processes having been worked out on a semi-commercial scale. A new chromatographic method has been developed for the separation of praseodymium.

Other industrial advances include the development of a process for the production from Indian bauxite of alumina free from titanium and containing only a trace of iron. Essentially a modification of the Bayer process, it depends on preliminary digestion of the ore with sodium hydroxide at a pressure of 150 lb. for 6 hours and subsequent precipitation of the alumina from the filtrate by carbon dioxide. Precipitation is complete in 3-4 hours, with a consequent saving of tank space. The red sludge from the filter press contains 30-35 per cent. of TiO_2, and a scheme for the recovery of this product has now been worked out on pilot-plant scale. Titanium tetrachloride, used in smoke screens, is being made from the ilmenite sands of Travancore and bauxite ore; from the sand, the titanium is first extracted as sulphate and then roasted at 500° C. in a current of chlorine either in a silica or a stoneware pipe. The tetrachloride which distils over is freed from ferric chloride impurity by fractional distillation.

Zinc sulphate is being prepared from the waste sludge of brass foundries and other works handling zinc by removing the impurities, iron and copper, by hydrolytic precipitation in the ferric condition and by electro-chemical precipitation respectively. Zinc oxide is then made by precipitating zinc carbonate and decomposing it by heating. The importance of vanadium pentoxide as an industrial catalyst has led to the investigation of methods for producing it from ores recently discovered in the Singhbhum district of Bihar; encouraging results have been obtained.

Plans for four laboratories in India are being considered by the Council of Scientific and Industrial Research. The new centres will provide facilities for chemical, physical, metallurgical and fuel research.

Volatilisation of Gold

Experimental Work in Australia

A METHOD of overcoming the serious loss of gold caused by volatilisation when concentrates are roasted is outlined in *Chemical Engineering and Mining Review* (1943, *35*, 414, p. 156) by Dr. B. H. Moore, of the Kalgoorlie School of Mines. The principles of the process are as follows:—

1. Volatilisation of the gold as auric chloride by heating the calcine in an externally heated furnace in an atmosphere of chlorine gas, without access of air.

2. Recovery of the volatilised auric chloride by solution in water in suitable wet scrubbing apparatus.

3. Recovery of the volatilised gold, partly by filtration and partly by the use of suitable precipitants.

The crux of the process is the presence of sufficient chlorine to prevent the decomposition of auric chloride.

Experimental work done in America and Australia has shown conclusively that there is no difficulty in volatilising the gold, but that the recovery of the volatilised gold by bag filters, water jets, etc., has been unsatisfactory owing, in the opinion of the writer, to the fact that auric chloride decomposes to extremely fine gold which resists all attempts at filtration or wetting by water or other liquids. In this earlier experimental work the volume of gases to be treated for recovery of the gold was enormous owing to the fact that a large volume of air was continuously passing through the furnace, whereas with the new process the only gas to be so treated was the slight excess of chlorine over that necessary for efficient volatilisation of the gold and prevention of auric chloride dissociation.

To test the method, volatilisation was conducted in a small electric furnace. The aim was to determine whether the gold volatilised under these conditions could be successfully recovered. With one typical sample of roasted flotation concentrates which contained 295.5 milligrams of gold, 265.5 milligrams of gold volatilised in 40 minutes, of which 258.2 milligrams were recovered. The exhaust gas from the chlorination furnace was drawn through a porcelain tube into a scrubber consisting of a glass cylinder filled with water and glass beads. Chlorine gas was passed into the sealed furnace direct from a chlorine generator, the furnace temperature being 700-800° C. The total gold recovered was made up as follows:—

		Milligrams
Deposited in porcelain tube,	water-soluble ...	24.8
	water-insoluble	35.0
Recovered from scrubber,	water-soluble ...	175.2
	water-insoluble	23.2
Total gold recovered,	water-soluble ...	200.0
	water-insoluble	58.2
		258.2

Potash Estimation

New Use of Radioactive Effect

FERTILISERS and other mixtures containing potassium possess radioactivity which can be used to measure the quantity of potassium present, according to R. Bowling Barnes and D. J. Salley, of American Cyanamid Company's Stamford (Conn.) Research Laboratories, in a report recently published by the American Chemical Society. Radioactivity of mixtures and compounds containing potassium is weak but measurable by extremely sensitive modern physical instruments, Dr. Barnes and Dr. Salley found. Furthermore, intensity of radioactivity of common materials is proportional to the quantity of potassium present. No other common element possesses this property. Utilising the Geiger Counter, Barnes and Salley have perfected a simple speedy method of analysing materials for their potassium content which surpasses chemical methods now used, in accuracy as well as speed.

In the new method the sample is merely dissolved in water, with or without the addition of an acid to assist the process, and the solution is introduced into a specially constructed glass counter tube. When the tube is properly connected to the counting instrument, tiny impulses caused by the radioactive changes in the potassium atoms of the sample actuate the counting mechanism. The number of counts registered per minute or per hour gives the amount of potassium present in the sample after suitable pre-determined corrections are applied. The entire operation requires only a few minutes or hours, as compared with a period many times longer necessary for the usual chemical analysis.—*The American Fertiliser*, 1943, *98*, 7, p. 18.

Plastics in Wales

Development Committee Appointed

AS a result of a meeting convened in Cardiff by the South Wales and Monmouthshire Industrial Development Association, a committee of technicians and industrialists has been appointed to explore the possibilities of plastics industry developments in South Wales and Monmouthshire.

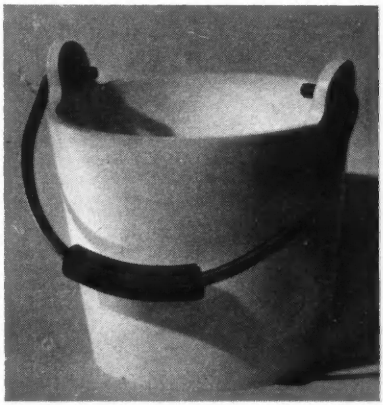
Dr. A. Caress, development director of I.C.I. (Plastics), Ltd., addressing the meeting, said that Wales could contribute fairly quickly to the first and last stages in the plastics industry. She could produce some of the chemical raw materials, which included coal and carbide, and there was no reason why she should not also produce many of the intermediate materials from coal. Fabricating industries should be established near large centres of population.

Councillor George Williams, O.B.E., Cardiff, chairman of the Industrial Development Association, was elected chairman of the special committee, while the following technicians and industrialists were elected members: Dr. W. Idris Jones, Colonel W. C. Devereux, Dr. C. F. R. Harrison, Messrs. Islwyn Jacob, John Curran, A. Bailey, Felix Schindler, Tom Evans, and S. F. Hines. Mr. D. J. Davies, Cardiff, was appointed committee secretary.

Acid-Carrying Buckets

A Substitute for Ebonite

SHORTAGE of ebonite and rubber buckets for handling acids and other corrosive chemicals in certain industries has not caused the difficulties which many engineers and works managers generally expected. One suitable alternative which is available for many of the applications is provided by the Lorival acid-carrying bucket, which is produced from cast phenolic resin. Experience over many years has shown it to be suitable for handling most of the chemicals used in industrial processes with the exception of caustic solutions and nitric acid. It is now being used in a variety of industries, including tanning, artificial silk manufacture, dyeing and bleaching, paper manufacture and the chemical treatment of metals. The bucket can be used in some cases where a rubber vessel would be unsuitable, and works concerned with handling organic solvents, such as 90's benzol and carbon tetrachloride can use it with confidence. It is supplied in a popular two-gallon size with a convenient carrying handle. Full technical data are available on application to the manufacturers, United Ebonite and Lorival, Ltd., Little Lever, Bolton, Lancs.



U.S. Conspiracy Charge

Titanium Monopoly Plan

THE U.S. Department of Justice announced on Monday night, says Reuter from Washington, that three American chemical companies had been indicted by a federal grand jury for creating a world-wide cartel in conspiracy with German, British, Italian, Japanese, and other foreign interests. Mr. Tom Clark, assistant Attorney-General in charge of the anti-trust division, said the cartel embraced titanium compounds used in the production of strategic war materials.

The companies, and four of their officials, are charged with the violation of the anti-trust laws. They include the National Lead Company; E. I. du Pont de Nemours and Co.; and the Titan Company, a subsidiary of the National Lead Company.

The indictment alleged that the defendants and the foreign companies divided the world into exclusive non-competitive areas, and in the United States obtained monopolistic control through the pooling of patents. Under this arrangement the British Titan Products Co., Ltd., owned jointly by Imperial Chemical Industries, Ltd., the Titan Company, Inc., and other British companies, received the British Empire. At the outbreak of the European war, the indictment says, the Titan Gesellschaft, jointly owned by I. G. Farben and the National Lead Company, was unable to supply South American markets. So the National Lead Company agreed to supply South American customers and pay the German company profits from such sales. This arrangement terminated when the United States entered the war. The Department of Justice said that other firms involved were Goodlass, Wall and Lead Industries, Ltd., the Imperial Smelting Corporation, Ltd., and National Titanium Pigments, Ltd., also known as B. Laporte, Ltd.

Lord McGowan has given the Press Association an absolutely flat denial that the I.C.I. is engaged in any international conspiracy. "We are not in combination with any international bodies," he said. "The report is quite wrong. I do not think it is necessary to elaborate on the denial."

LETTER TO THE EDITOR

Electrolytic Hydrogen

SIR,—In THE CHEMICAL AGE on May 1, 1943 (1244, p. 475), are published typical analysis figures of hydrogen produced electrolytically, *viz.*, Hydrogen 99.8 per cent., Nitrogen 0.15 per cent., and Oxygen 0.05 per cent. The occurrence of nitrogen in electrolytic gas is a somewhat new feature, and must be due to tests of hydrogen taken on insufficiently purged pipes. From our long experience of electrolytic hydrogen from the Knowles cell, the typical analysis is Hydrogen 99.95 per cent., Oxygen 0.05 per cent.

It must be pointed out in all fairness to the electrolytic method, that the hydrogen requires no subsequent purification as with steam-iron hydrogen, and, judging from the number of recent patents, it would appear that purification demands considerable attention. Even the small proportion of carbon monoxide left in steam-iron hydrogen suffices to poison the catalyst slowly and retard hydrogenation.

As far as cost is concerned, electrolytic cells are automatic and run with the minimum of attention, some having been in continuous operation for 20 years without replacement. In chemical factories the price of electricity is more often below ½d. per unit than above, and in some cases is as low as 1/10d. per unit. Hence it is reasonable to conclude that electrolytic hydrogen competes most favourably with steam-iron hydrogen, and, having no carbon monoxide impurity, is the more efficient method for hydrogenation plants of any capacity.—Yours faithfully,

For The International Electrolytic Plant Co., Ltd.,
W. J. B. CHATER B.A.,
Chemist.

June 25, 1943.

POTASSIC FLUE DUST

Our attention has been called to the fact that an error was made in the table which appeared at the foot of p. 645 (THE CHEMICAL AGE, June 19) giving comparative figures of the effect of flue dust and sulphate of potash on crop yield. The results of three series of field trials are correctly stated as under :

Crop yields in three series of field trials in which flue dust was applied to potatoes.

	Total weight of crop per acre. Series 1 Tons/Cwt.	Series 2 Tons/Cwt.	Series 3 Tons/Cwt.
Amount of potash supplied :			
No potash : (control experiment)	5.2	8.2	7.10
Flue Dust : 4½ cwt.	5.18	9.13	9.13
Sulphate of Potash : 1 cwt.	5.18	10.3	9.19

General News—From Week to Week

Prospective candidates for the September examinations of the Royal Institute of Chemistry are reminded that the last date for actual entries and payment of fees is July 19.

The Safety in Mines Research Board, in its latest report, states that stone-dusting is the only effective safeguard against coal-dust explosions.

A donation of £2 10s. has been received by the Merchant Navy Comforts Service from the Board of I.C.I. (General Chemicals), Ltd., St. Rollox Works, Glasgow.

That Newfoundland talc is a suitable substitute for French chalk is the conclusion drawn from experiments carried out by the Printing and Allied Trades Research Association.

The Ministry of Food announces that the only change in the existing prices of oils and fats allocated to primary wholesalers and large trade users during the five weeks ending July 31, is: Rapeseed oil increased by £2 to £60 per ton naked ex works.

The Post Office asks business subscribers to see that their old telephone directories are sent for salvage when they receive the new A to K edition. Wherever practicable the Post Office will collect the old books, but shortage of labour makes this impossible in many cases.

The inaugural meeting of the Manchester group of the International Society of Leather Trades' Chemists was held on June 19, at the Engineers' Club, Manchester, the preliminary proceedings being presided over by Dr. D. Burton. Mr. G. J. Cutbush was elected chairman and Mr. R. Denyer hon. secretary.

A fuel research board for Scotland was advocated by Sir Patrick Dollan last week to a gathering of gas managers. He said that such a board was needed to ensure co-ordination and co-operation in all the Scottish fuel industries. It was his opinion that not enough money was being spent on research in this country.

Sir John Anderson, Lord President of the Council, this week received a deputation from the Parliamentary and Scientific Committee led by Lord Samuel and Mr. E. W. Salt, M.P. The subject under discussion was the steps that might be taken to implement the committee's recommendations contained in their recent report on coal utilisation.

Suphanilamide can be used to distinguish between various plant fibres, according to a note in *Journal of Chemical Education* (May, 1943). Reagent used is a 2 per cent. sulphanilamide solution in water with 1 per cent. conc. hydrochloric acid. Sisal and other fibres containing lignin develop a bright orange colour in 30-60 seconds; hemp, on the other hand, gives no reaction.

An extension of ten years on their present lease, with the option of five further years, has been granted by Dundee Town Council to William Briggs & Son, Ltd., tar distillers, for the manufacture of by-products from the city's gas coal. A clause in the new agreement permits the Corporation to participate in Scottish Tar Distillers' prices without being associated with them.

The British Rayon Federation was formally constituted at a meeting of the Rayon Council on June 24. Mr. Samuel Courtauld was elected president and Mr. Colin M. Skinner was elected vice-president. Sir Percy Ashley and Mr. A. D. Carmichael were appointed chairman and vice-chairman respectively. Mr. J. C. Burgess will act as secretary *pro tem.* With the setting up of the Federation the present Rayon Council is dissolved.

Foreign News

Canada's salt production for 1942 was 658,458 tons, an increase of 16 per cent. over the preceding year.

Chemical A. G. of Vienna is erecting a new plant for making saccharin and other products.

Prices of chemical and pharmaceutical products in Brazil are to be fixed by the Government.

Thirty-three Chinese engineers have arrived in America to study U.S. engineering techniques. Four of them are chemical engineers.

Profits from plumbago mining come under the excess-profits tax which has been effective in Ceylon since the autumn of 1941.

Nigeria is to grow more sesame, a plant which produces an oilseed having a six per cent. higher oil content than the groundnut.

Methyl bromide is under strict control in Canada. All fire-fighting equipment using this chemical is reserved for the Canadian and British air forces.

The Government of Australia has set up an Industrial Chemical Committee to recommend measures for the expansion of the chemical industry.

The Industrial Development Board of Saskatchewan plans the establishment of three plants to manufacture alcohol, at Kamsack, Lloydminster, and Estevan.

Many thousands of gallons of Barbados molasses are to be bought by the United States this year, though Canada's needs will have first call on available shipping.

A new cement plant is under construction at Juan Soldado, Chile, and the required capital of 40 million pesos has already been over-subscribed.

The Argentine Government plans to spend 24,000,000 pesos for the construction and equipment of a plant to produce power alcohol from cereals and potatoes.

Argentina's imports of chemicals, oils and paints increased in value from 112,700,000 paper pesos in 1941 to 140,000,000 pesos in 1942.

The American Exposition of Chemical Industries will be held in Madison Square Garden, New York, during the week December 6-11.

Brazil's output of aluminium sulphate, formerly insufficient for domestic needs, has been stepped up considerably. ' Production is now estimated at 500 to 600 tons per month, which is at least double the pre-war figure.

Spain's potash alum production amounts to 170,000 kilograms a year. Leading producers are S.A. de Productos Quimícos, Luis Corbalán Alvarez and Productos Electrolíticos S.A. y Química Asturiana.

Average monthly production of copper in Spain has risen from 10,900 tons in 1941 to 12,000 tons in 1942 and 13,500 tons in the first months of 1943, according to German wireless reports.

The King Island scheelite mine in Australia is producing 3 to 4 tons of scheelite concentrates a week, according to recent returns. Arrangements have been made to increase the output.

America is short of industrial oxygen and calcium carbide. It is expected that these shortages will continue until next year, by which time new plant will have come into operation.

Alligator oil, mixed with fuel oil, is being used in the electric power plant at Tefé, Brazil. Before the war a Swiss firm contemplated using oil from alligator livers in the perfume industry.

A new type of charcoal, that is the result of experiments in the island's petroleum industry, is being produced on a commercial scale in Trinidad. It is said to be satisfactory for domestic purposes, and small lots have also been sent to Barbados.

Wood saccharification in Switzerland is still of doubtful economic value. Holzverzuckerungs A.G. of Ems (Graubünden) reports that it makes only methyl alcohol from waste wood. The price of imported alcohol has risen to such an extent that subsidies are no longer required.

Aerial photographs of the synthetic rubber factory at Hüls, bombed by Flying Fortresses last week, show that no part escaped damage. This plant, the second largest of its kind in Germany, was built in 1940, and was later enlarged until now it occupies nearly a square mile.

A new explosive, 35 per cent. more powerful than T.N.T., is now being used by the United States Army, according to Major-General L. M. Campbell, Chief of U.S. Army Ordnance in Chicago. It is called R.D.X.

The synthetic malarial atebrin is playing an important part in the exploitation of the Para rubber area on the Amazon. Incidence of malaria has been reduced from 15 per cent. to 2-3 per cent.

Cotton-seed from Uganda is now being used as fuel instead of coal by several East African factories. It is also used as fertiliser on tea, coffee, rubber and sugar plantations, and it is also being used as a cattle food by Kenya farmers, who mix it with sesame cake.

Production of shale-oil from bituminous sands near S. Paulo is now engaging the attention of the Companhia Itatig, the only private oil enterprise of any importance in Brazil. A daily production of 50,000 litres is hoped for.

Anhydrous ammonia is a new Brazilian product. The present output of 300 tons annually will meet local demands. Chromium salts from Brazilian ore are also being manufactured as an aid to the tanning industry.

A Swedish mining company is enlarging its plant for producing apatite from iron-ore refuse, from which it is estimated that superphosphate works will be able to make 200,000 tons a year, the country's minimum requirement.

Brazil is extending exploitation of her mineral resources with the development of graphite deposits in Rio de Janeiro, tungsten in Minas Gerais, and nickel exploration in Goyas. Search is being conducted, too, for additional sources of quartz crystals, coal and nickel, the United States furnishing technical aid.

Forthcoming Events

The annual general meeting of the **Society of Chemical Industry** takes place at the Royal Institution on **July 9,** at 2.30 p.m. The business portion of the meeting will be followed, at 4.45 p.m., by the presentation of the Society's Medal to Dr. L. H. Lampitt, and the Medallist's address.

The Institute of Physics (Industrial Radiology group) will hold an open discussion at 2.30 p.m. on **July 10,** when miscellaneous questions on industrial radiology, sent in by members, will be submitted to those present for discussion. Mr. D. E. Thomas, vice-chairman of the group, will select suitable questions and direct proceedings. The meeting will be held at the Institution of Electrical Engineers, Savoy Place, London, W.C.2.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for errors that may occur.

Mortgages and Charges

(Note.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.)

MERZ & CO., LTD., London, E.C., manufacturing chemists. (M., 3/7/43.) June 10. £1500 debentures; general charge. *Nil. March 17, 1942.

Satisfaction

FLEETWOOD CHEMICAL CO., LTD., London, S.E. (M.S., 3/7/43.) Satisfaction June 11, of debentures registered May 20, 1939, to the extent of £210.

Company News

British Glues & Chemicals, Ltd., announce a first and final ordinary dividend of 10 per cent. (same) and 1 per cent. participation on the 8 per cent. preference (same).

The Distillers' Co., Ltd., announce a profit of £1,947,221 (£1,962,168) for the year ended May 15. A final dividend of 8¾ per cent. is being paid, making 16¼ per cent. (same). Forward, £514,334 (£524,210).

The British Thermostat Co., Ltd., are paying a final dividend of 11 per cent., making 18½ per cent., less tax (same). Preliminary profit for the year to January 31 is £34,754 (£29,846).

Peter Brotherhood, Ltd., have declared a final ordinary dividend of 12 per cent., making 20 per cent. (same) for the year ended March 31. Profit for the year was almost the same, at £60,410 (£60,387).

Johnson Matthey & Co., Ltd., report a profit for the year to March 31, of £406,546 (£164,453). To taxation £200,000 (£60,000), rebuilding £35,000 (nil), goodwill £50,000 (nil). Final ordinary dividend 7 per cent., making a total of 10 per cent. (same). Forward £275,027 (£254,747).

Chemical and Allied Stocks and Shares

BUSINESS in Stock Exchange markets has again been on a moderate scale, but values in most sections were inclined to improve, and in some instances shares of companies in the chemical and kindred industries were slightly higher on balance. Imperial Chemical showed firmness at 39s. 3d. and remained in demand under the influence of the yield of over 4 per cent., which is slightly above the average return on leading industrial shares. The units of the Distillers Co. were firm at 85s. on the maintenance of the dividend at 16¼ per cent., while Dunlop Rubber rallied from 36s. to 37s. 3d., and Turner & Newall were 76s. Yields on the latter are small, as are those on most other shares of companies which are favoured in the hope that after the war there may be reasonable possibilities of improvement in earnings and dividends.

British Plaster Board 5s. ordinary were firmer at 28s. 9d. pending declaration of the dividend, while Associated Cement were 58s. Tunnel Cement 10s. shares were 50s., at which the yield is 4 per cent. on the basis of the 20 per cent. dividend maintained for the past financial year. Rayon shares held recent gains, and were inclined to be more active on hopeful views of the long-term outlook and the possibility of an upward trend in profits after the war. Courtaulds were 50s. 6d. and British Celanese 10s. shares 22s. Other securities which were inclined to improve on views as to the outlook after the war included Gas Light & Coke ordinary, which were firm at 18s. 3d. In other directions, Barry & Staines remained at 40s. pending publication of the results, and Nairn & Greenwich kept at 66s. 3d., awaiting declaration of the interim dividend.

Paint shares were firm and inclined to improve under the lead of Lewis Berger, which at 85s. 6d. have shown further response to the recent announcement regarding the company's interests in plastics. Among other shares of concerns associated with plastics, Thomas De La Rue were active, and changed hands up to £6⅝; British Industrial Plastics 2s. ordinary were again 5s. 10½d., Erinoid 11s. 6d., and Lacrinoid Products 4s. 6d. Elsewhere, British Glues & Chemicals 4s. ordinary kept their improvement to 8s. 1½d., pending the dividend announcement.

B. Laporte remained firmly held and were again 78s. "middle." W. J. Bush were quoted at 53s. 9d.; the 5 per cent. £5 preference shares marked £5½ at one time. At 14s. 6d. Goodlass Wall 10s. ordinary continued to hold their recent improvement. Dealings around 7s. were shown in Greeff-Chemicals 5s. ordinary, and up to 19s. 6d. in Burt Boulton. Cooper McDougall changed hands up to 30s. and Fisons up to 46s. 6d. Business at 8s. 1½d. was recorded in Blythe Colour 4s. ordinary, and at 12s. 3d. in Lawes Chemical. Lever & Unilever were little changed at 33s., while Lever N.V. at 32s. 3d. were the same as a week ago. Murex eased to 102s. 6d., British Aluminium were 48s. 6d., and British Oxygen 73s. 3d. The shares of the Metal Box Co. were steady at 89s. 9d. Results of the last-named company for the

financial year ended March 31 are due shortly; the prevailing assumption is that the dividend is likely to be kept at 17½ per cent., the rate which has ruled for some years.

Among iron and steel issues those of Dorman Long were lower, but Guest Keen were little changed at 32s. 9d., while Babcock & Wilcox were 48s., and United Steel 25s. 7½d. Stewarts & Lloyds were 50s. 3d. and Tube Investments 91s. 3d. Allied Ironfounders moved higher at 50s. and Amalgamated Metal shares were quoted at 17s. At 15s. 9d. General Refractories showed a small gain on balance. Low Temperature Carbonisation 2s. shares were better and quoted slightly above their par value. United Glass Bottle eased to 60s., but Triplex Glass were little changed at 31s. 6d.; Forster's Glass 10s. ordinary were firm at 28s. 6d.; the full results show that a dividend of nearly 28 per cent. was earned last year, so that the 15 per cent. distribution is again conservative. Oil Shares were inclined to improve; the "Shell" annual statement mentions that an appreciable part is being taken by the group in the production of synthetic rubber.

British Chemical Prices

Market Reports

A STEADY demand has been maintained in all sections of the industrial chemicals market during the past week and contract deliveries to priority consumers have covered good volumes. A fair inquiry for new business is reported but orders are difficult to place unless for absolutely essential purposes. Prices are unchanged at recent levels and the undertone continues firm. In the soda products section hyposulphite of soda and chlorate of soda are active items, while strong values and a restricted supply position is ruling in the section for potash products. A good demand for the lead oxides is maintained at unchanged rates. Formaldehyde and acetone are in good request, while there is a good call for most of the heavy acids with offers of oxalic, tartaric, and citric acids below current requirements. Elsewhere, there is a sustained demand for insecticides. Activity in the coal-tar products section is mostly confined to contract deliveries and on the whole supplies are being steadily absorbed. A better inquiry is reported for pyridine and pitch.

MANCHESTER.—Inquiry has largely exceeded the volume of actual new business on the Manchester chemical market during the past week, difficulties in arranging near deliveries making their influence felt. Textile chemicals are in fair demand against contracts and delivery specifications are also circulating reasonably satisfactorily from most other consumers. So far as prices are concerned, the position geerally is much the same as a week ago, though in a number of directions the markets are extremely strong and a further stiffening would not be surprising. With regard to the by-products values are firm throughout and most classes of both light and heavy distillates are going into consumption in good quantities.

GLASGOW.—In the Scottish heavy chemical trade there is no change during the past week, home business maintaining its steady day-to-day transactions, while export trade is rather restricted. Prices remain very firm.

Price Changes

Magnesium Chloride.—MANCHESTER: £15 to £17 per ton (solid, ex wharf).

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88/96	Hor.	4-cyl. Crossley	375	
80/90	Vert.	4-cyl. Ruston	500	
78/86	Hor.	Single Crossley	240	
72/80	Hor.	Single Crossley	230	(Three)
32/75	Vert.	4-cyl. Dorman	600/1500	
57	Vert.	3-cyl. Ruston	450	
48/53	Hor.	Single Crossley	270	
48/52	Hor.	Twin Crossley	375	
50	Hor.	Single Tangye	210	
42/46	Hor.	Single Ruston	250	
45	Hor.	Single Blackstone	250	
42	Hor.	Single National		(Two)
40	Vert.	Single Petter	330	
35/39	Hor.	Single Crossley	310	
36	Vert.	Single Petter	500	(Two)
32/35	Hor.	Single Crossley	330	
32	Hor.	Single Crossley	330	
23/25	Vert.	Single Crossley	450	(Three)
24	Hor.	Single Fielding & Platt		
20/22	Vert.	Single Crossley	400	
20/22	Hor.	Single National	375	
16/17½	Vert.	Single Crossley	500	
18	Hor.	Single Crossley	400	
12/14	Vert.	Single Petter	525	(Two)
12	Hor.	Single Keighley	480	
9/10	Hor.	Single Crossley	475	
8/10	Vert.	Single Petter	550/680	
10	Vert.	Single Petter	680	

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THE Proprietors of the Patents No. 503,634 for "Improvements in or relating to the stabilisation of polyvinyl acetal resins," No. 508,105 for "Improvements in methods of forming polyvinyl acetal resin sheets," No. 509,596 for "Improvements in plasticised polyvinyl acetal resins," and No. 509,696 for "Improvements in plasticised polyvinyl acetal resins" are desirous of entering into arrangements by way of licence and otherwise on reasonable terms for the purpose of exploiting the same and ensuring their full development and practical working in this country. All communications should be addressed in the first instance to Haseltine Lake & Co., 28 Southampton Buildings, Chancery Lane, London, W.C.2.

The fact that goods made of raw materials in short supply owing to war conditions are advertised in this paper should not be taken as an indication that they are necessarily available for export.

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